



FROM THE WEST AND NORTHWEST  
TO THE SEA

BY WAY OF

THE NIAGARA SHIP CANAL.

BY

WM. PIERSON JUDSON,

MEM. AM. SOC. C. E.

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1890.

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# From the West and Northwest to the Sea.

By Wm. Pierson Judson, Mem. Am. Soc. C. E.

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The West and Northwest must have the best possible waterway to the sea. The best waterway is that by which the largest practicable lake steamers can go nearest to the sea, by deep-water navigation, without breaking bulk.

Such a route can be made either through the United States or through Canada, and the great profits of the carrying trade, which is vastly increasing every year, and which exceed the profits of production, will go to that nation which provides the best way.

Each government has expended large sums to improve their natural waterways; the present magnitude of the commerce calling for these improvements being indicated by the 20,000,000 of tons passing the St. Clair Flats Canal yearly.

The United States has met the demand by the construction of the Sault Saint Mary Canal at the outlet of Lake Superior, having the finest and largest lock in the world, with a still larger one\* now in progress; also, by the excavation of the St. Clair Flats Canal at the outlet of Lake Huron, and by the deepening of the Detroit River, at the entrance to Lake Erie.

The latter being completed and the others in progress to pass 20 feet draught.

The logical sequence of this liberal policy, each step of which has been followed by a great growth both in size and

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\* Eight hundred feet long between gates, 100 feet wide in gates as well as in chamber, and 21 feet deep on miter sills. Report Col. O. M. Poe, Corps of Engineers, An. Rep. Chf. Engineers, U. S. A., 1889, p. 2223.

number of vessels and in volume of commerce, is to also provide a similar 20-foot waterway from Lake Erie to Lake Ontario.

The Western demand for this further step toward their eastern market, was recognized by the last Congress in its call for plans and estimates for a 20-foot ship canal around Niagara Falls.

These estimates,\* reprinted here, were made and submitted to Congress; where they were soon followed—on December 18, 1889—by the introduction, by Congressman Sereno E. Payne (since made Chairman of the Committee on Railways and Canals), of a bill, also here reprinted—providing for the work. This bill now awaits Congressional action.

The essential points of the plans and estimates are also embodied on the sheet of maps and profiles which have been made for, and which accompany, this paper. The map shows some of the main connecting and competing lines of both railways and canals, with the Niagara region on a larger scale.

The profiles show the two practicable routes, which are the only ones, of many surveyed, which are worthy of consideration for the large locks (400 x 80 x 21 feet) now desired.

The eighteen locks estimated for, take as their model the 1881 lock of the Sault Saint Mary Canal, which, being designed to pass two or more vessels at once, is, therefore, larger than needed for the Niagara Canal, being 515 feet long, 80 feet wide and 16 feet deep.

This lock, with its unique methods of operation, has had nine years of uninterrupted use, and all its details have been proven to be so perfect as to leave no room for improvement: A most fitting monument to the skill and wisdom of the late General Godfrey Weitzel, who planned and built it, having, as the only comparable precedent, his own similar works in 1871, on the Louisville Canal at the Falls of the Ohio.

Of the two routes selected for the Niagara Ship Canal, the longer one of 25 miles, known as the Lockport—Olcott,

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\* Report Capt. Carl F. Palfrey, Corps of Engineers, An. Rep. Chf. Engineers, U. S. A., 1889, p. 2434.

or 18-mile creek route—is preferable, and is estimated to cost \$23,000,000.

It offers remarkable natural advantages for construction as well as for operation, in the "Lockport Gulf," two and one-half miles long, in which the descent is made, and also in the 18-mile creek gorge, 4 miles long, by which Lake Ontario is reached.

It is to be regretted that the striking features of the routes selected cannot be here shown better than by description, by reproducing a series of photographs taken by the writer in 1889, while examining in detail the various lines.

The six millions greater cost of the Wilson route, which is 5 miles shorter, is due in part to its lack of the natural features above referred to, and in part to the necessity for doubling nine of the locks to obtain the service which single locks give on the Olcott line.

The United States Government has not been alone in its works for the Lake commerce, for meantime the Canadian Government, despite its comparatively small population and limited resources, has spent some fifty-four million dollars in constructing and recently in enlarging its canal system, with a view to controlling the western trade.

This system now consists of the 14-foot Welland Canal from Lake Erie to Lake Ontario, around Niagara Falls, and of the St. Lawrence River Canals, around the various rapids by which the outflow of the lakes descends from Lake Ontario, through 246 feet of fall, to tide water at Montreal.

These last named canals—six in number, with twenty-six locks—have an original depth of 9 feet, which is now in process of increase to 14 feet.

From Montreal, now practically a seaport, a 27½ to 30-foot channel for seagoing steamers has been made at a cost of some \$2,500,000, their voyage thence to Liverpool being 315 miles less than from New York.

That portion of the shipment from the upper lakes which passes through the United States and reaches New York, is taken from Lake Erie at Buffalo by 352 miles of the 7-foot Erie Canal to the Hudson; and from Lake Ontario at Oswego by the two branches of the Erie Canal, *via* Syra-

cuse and *via* Oneida Lake, the latter route having 184 miles of canal and river and 23 miles of Oneida Lake travel to reach the Hudson.

The deep waters of Lake Ontario are now, however, practically unused for this traffic, the only important western shipments passing through it for American ports being to Ogdensburg, for shipment thence by rail; the only access to Lake Ontario from the West being through the 14-foot Canadian Welland Canal.

This is too small to pass the larger upper-lake steamers, and the discrimination in tolls which is made against vessels bound for American ports is such as to be almost prohibitory. Nominally, the tolls are the same to all vessels, and are twenty cents per ton of cargo and two and one-half cents per ton of vessel; but the amount is refunded or rebated to vessels which deliver their cargoes at a Canadian port.

Observation of the map will recall the striking advantage of Canada's position as regards the lakes, and will suggest that the United States can not afford to omit any reasonable work which will offset this natural advantage.

The works best calculated to effect this, and which also promise the greatest value, aside from any competitive aspect of the case, are the Niagara Ship Canal to the East, and the projected Lakes and Gulf waterway to the South; the latter running from Chicago and carrying the waters of Lake Michigan along the line of this original natural outlet down the valley of the Illinois River to the Mississippi and the Gulf.

These two projects, which are both strongly favored, should not be considered as rivals, since many of the reasons for one are equally applicable for the other, and their combined effect, added to the present great growth of lake shipping, would supply ample business for both.

The latter project is most ably presented by Mr. L. E. Cooley, C.E., of Chicago, in his publication of 1888, containing a great amount of valuable data, and also in a subsequent discussion of it published in 1889 under his direction.

Already Canada is taking further steps to improve the natural advantages of her position by completing a separate canal system. Not content with using the United States

Sault Saint Mary Canal, Canada has now in progress (1890) a similar canal on the opposite side of the Rapids less than a mile from ours.

This great work is undertaken despite the fact that the United States Canal is free of tolls to Canadian vessels as well as to our own.

The contracts for the entire work are now in force, providing for an 18-foot canal, with lock 600 × 85 feet, operated by hydraulic machinery. The contracts call for the completed work to be ready for use in May, 1892.\*

When the Canadians are thus made independent of our "Soo" Canal, what terms may our vessels expect at the Welland?

On the other hand, it has been asserted that all tolls will then be removed from the Welland. The policy as regards United States vessels may vary with every change of ministry. No terminal arrangements can be made with any assurance of permanence, so long as we must depend upon a Canadian Canal.

Surveys and estimates have also been made for an almost direct line of waterway from the Sault Saint Mary and from Lake Michican, to Montreal, through Lake Nipissing and the Ottawa River: The latter having already canal navigation for 9 feet draught to Ottawa, and for 5 feet draught 145 miles beyond; though at present the 5-foot portion is not kept in repair.

A glance at the map accompanying will show that this line, lying far within Canadian territory, would cut out Lakes Huron, St. Clair, Erie and Ontario, as well as the St. Lawrence Rapids, thus saving 270 miles. The distance by it is practically the same from Lake Superior to Montreal as by the present lake route from Lake Superior to Buffalo.

Its construction, even for a nine-foot barge route, is not probable, but the possibility exists—for the route offers great advantages: The summit level, 77 feet above Lake Huron, has ample water supply, and in the total length of 430 miles, only 29 miles is canal; the rest being river and lake.

\*Annual Report Canadian Minister Railways and Canals, Ottawa, 1890, page 111.

†Annual Report Canadian Minister Railways and Canals, Ottawa, 1890, page 103.



The object in here stating, at such length, the present and prospective features of the Canadian Routes, is to show that New York City, as well as the West and Northwest, directly interested in the effects of the proposed works.

The result of Canada's liberal policy is already shown in the gradual increase in Montreal's share of the total exports, while New York's share as steadily decreases.

The reverse has recently been stated to be the case, but these comparative percentages are carefully computed from official records of the several Chambers of Commerce or Produce Exchanges, and show a gradual change, in ten years past, of 4 per cent. in grain and 5 per cent. in flour, in Montreal's favor.

This gain has been made despite of Montreal's having "only six months of the year of navigation," as stated by one of her most noted engineers. The actual average dates\* of first arrivals and last departures for many years past have been May 2d and November 23d.

A stronger and fairer showing would have been made, if there could have been included the Canadian shipments brought in bond *via* the Grand Trunk Railway to Portland, Maine, and exported thence when Montreal's harbor was sealed by ice.

Portland being practically Montreal's winter port.

COMPARISON of Exports of Grain and Flour, from New York City and from Montreal, showing the percentage of the sum total which each city exports:

GRAIN, BUSHELS. PERCENTAGE OF SUM TOTAL.

	1880	1881	1882	1883	1884	1885	1886	1887	1888	1889
New York.....	84	83½	82½	82	83	82½	77	80	82	80
Montreal .....	16	16½	17½	15	17	17½	23	20	18	20

FLOUR, BARRELS. PERCENTAGE OF SUM TOTAL.

	1880	1881	1882	1883	1884	1885	1886	1887	1888	1889
New York.....	85	87½	85½	85	82½	84½	82½	81½	82½	79½
Montreal.....	15	12½	14½	15	17½	15½	17½	18½	17½	20½

\* Annual Report Harbor Commissioners of Montreal, 1887.

A further similar comparison of the respective percentages of total exports of New York City and of the other North Atlantic ports, including Montreal, shows even more clearly that no effort can be spared if New York is to keep her present supremacy.

The percentages only are given, as the fluctuations of yearly quantities, with the varying supply and demand, are less readily compared.

COMPARISON of Grain and Flour Exports from New York, Boston, Philadelphia, Baltimore and Montreal, showing the percentage of their sum total which each city exports:

GRAIN, BUSHELS. PERCENTAGE OF SUM TOTAL.

	1880	1881	1882	1883	1884	1885	1886	1887	1888	1889
New York.....	49 $\frac{3}{4}$	50 $\frac{1}{2}$	55 $\frac{1}{2}$	49 $\frac{1}{2}$	52	53	49 $\frac{1}{2}$	52 $\frac{3}{4}$	56	49
Boston.....	6 $\frac{1}{2}$	7 $\frac{1}{2}$	5 $\frac{1}{2}$	6 $\frac{1}{2}$	5 $\frac{1}{2}$	6 $\frac{1}{2}$	6 $\frac{1}{2}$	6 $\frac{1}{2}$	9 $\frac{1}{2}$	9
Philadelphia.....	13	10 $\frac{1}{2}$	7 $\frac{1}{2}$	9 $\frac{1}{2}$	8 $\frac{1}{2}$	10	7 $\frac{1}{2}$	10 $\frac{1}{2}$	4	5 $\frac{1}{2}$
Baltimore.....	21	21 $\frac{1}{2}$	20 $\frac{1}{2}$	24	23 $\frac{1}{2}$	19	22 $\frac{1}{2}$	17	17 $\frac{1}{2}$	24 $\frac{1}{2}$
Montreal.....	9 $\frac{1}{2}$	9 $\frac{1}{2}$	11 $\frac{1}{2}$	11	10 $\frac{1}{2}$	11 $\frac{1}{2}$	14 $\frac{1}{2}$	13 $\frac{1}{2}$	13	11 $\frac{1}{2}$

FLOUR, BARRELS. PERCENTAGE OF SUM TOTAL.

	1880	1881	1882	1883	1884	1885	1886	1887	1888	1889
New York.....	62 $\frac{1}{2}$	66 $\frac{1}{2}$	62 $\frac{1}{2}$	57	45	47 $\frac{1}{2}$	41 $\frac{1}{2}$	38 $\frac{1}{2}$	40 $\frac{1}{2}$	40 $\frac{1}{2}$
Boston.....	16	15 $\frac{1}{2}$	18	22 $\frac{3}{4}$	36 $\frac{1}{2}$	21 $\frac{1}{2}$	24 $\frac{3}{4}$	20	17 $\frac{1}{2}$	15 $\frac{1}{2}$
Philadelphia.....	3 $\frac{1}{2}$	2 $\frac{1}{2}$	2 $\frac{1}{2}$	4 $\frac{1}{2}$	3 $\frac{1}{2}$	8 $\frac{1}{2}$	5	4 $\frac{3}{4}$	7 $\frac{1}{2}$	6 $\frac{1}{2}$
Baltimore.....	7	6	6 $\frac{1}{2}$	5 $\frac{1}{2}$	5	14	20	28 $\frac{1}{2}$	26 $\frac{1}{2}$	27 $\frac{1}{2}$
Montreal.....	11	9 $\frac{1}{2}$	10 $\frac{1}{2}$	10	9 $\frac{1}{2}$	8 $\frac{1}{2}$	8 $\frac{1}{2}$	8 $\frac{1}{2}$	8 $\frac{1}{2}$	10 $\frac{1}{2}$

It has been objected that the proposed 20-foot Niagara Ship Canal would pass the great upper-lake steamers to Lake Ontario, only to see their cargoes go down the St. Lawrence to Montreal, instead of through the Oswego and Erie Canal to New York.

As has already been stated, the navigable depth of the St. Lawrence River and canals, to Montreal, is now limited to 9 feet, with an ultimate proposed depth of 14 feet, to which

portions have been deepened. A 20-foot Canadian system would be impracticable, having been estimated to cost \$70,000,000 additional; while deep-water navigation, among its Thousand Islands and its thousands of submerged rocks, would require most skillful pilotage in clearest weather.

These dangers to navigation on the St. Lawrence increase vastly in number for any additional draught.

Twenty-foot vessels which might pass our canal, and desire to transfer at Kingston to barges for Montreal, would be prevented by the same rebate system which now operates so effectively against us on the Welland Canal.

So that there are both physical and financial sureties that New York, as well as the West and Northwest, could lose nothing, but must gain much, by the proposed Niagara Ship Canal.

It is now fortunate that its construction was not begun in 1867, upon the inefficient scale then proposed, which is practically that of the present Welland Canal, which was outgrown before it was finished. The canal, when built upon the present project, will pass the largest steamers which can navigate the lakes.

These steamers will be able to place their cargoes at Oswego twenty hours after passing Buffalo; this assumes a much quicker passage of the proposed canal than is possible, or is permitted, in the Welland Canal, whose passage is not allowed to be made in less than twenty-two hours. This appears to be fixed on a basis of 5 miles per hour speed and forty minutes per lock.

The shorter time here estimated for is based upon the improved methods proposed. The lockages will be fewer, and each will be quicker by reason of the hydraulic appliances and the methods of filling and emptying, which have proved so perfect at the Sault Saint Mary lock. This, at the Sault, requires the movement of five times the water moved in a Welland lockage, but it is effected, quietly, in an average of twelve minutes for each filling or emptying; while an additional twenty-eight minutes is required to haul in and to place the two to four vessels which fill the lock, to close and open the gates and to haul the vessels out—in all, an average of forty minutes per lockage.

The writer is indebted to General O. M. Poe, United States Engineers, who has charge of the canal and is building the new lock, for these details of operation.

In the Niagara locks, one-fourth smaller, a single steamer will readily pass in thirty minutes.

The earth slopes being paved, speed can be made on the two long levels of 6 and 12 miles each, which form three-fourths of the total length.

The Niagara Canal can be thus passed in eleven hours, and the run of 110 miles to Oswego can be made in eight hours. At Oswego, the cargoes transferred to canal-boats are then 145 miles nearer to New York than at Buffalo, and have 168 miles less of canal to traverse to reach the Hudson.

The average of many trips to the Hudson, of steam canal-boats with consort, shows six days from Buffalo against four days from Oswego.

This shows a clear saving of one and one-fifth days, or 20 per cent. of the time of the present trip from Buffalo.

Having two independent and competing water-routes available, shippers would also save the present excessive elevator charges at Buffalo.

It is no part of the present Niagara Ship Canal project to provide for a canal of similar size through New York State to tide-water, as has been estimated for at various times, by which Lake steamers should carry their cargoes to New York or to Europe.

Such projects call for impossible expenditures, and ignore the fact that different waters demand different types of vessel. The lakes, the canal and river, and the ocean, each have their distinctive style and equipment.

Such a waterway, if built, would not be so used. Steamers fitted to safely weather lake storms would not carry their costly and idle equipment through 360 miles of canal and river to New York. Barges of one-tenth the cost would do the work better and cheaper, while much of the expensive construction needed on the ocean would be superfluous on the lakes.

The present 7 foot canal will be fully equal to vastly greater business than it has ever done, when the double-

length locks—220 feet long by 18 feet wide—now in construction on the Oswego and Erie Canals, are completed, and when the present prism is cleared of accumulations and weeds, and its slopes paved, as has been repeatedly urged by the State Engineer. Or if enlarged to 9 feet depth at the locks, with 10 feet waterway, the present canal would pass the modern McDougal steel barges, or other canal-boats of ample size to do most efficient and profitable service.

For such enlargement of the Oswego, Oneida Lake and Erie Canal moderate estimates of cost have been made, and ample local water supply found.\*

The military advantage to the United States of being able to bring gun-boats through from New York Harbor is obvious. Gun-boats of 12 feet draught could readily be lightened of their armament and stores to pass the 9 foot canal and from it, through the Niagara Ship Canal, the chain of lakes could be commanded, with the effect of saving, in case of merely threatened hostilities, much greater sums than the canal would cost.

The only gun-boats which can now reach the lakes are those which may come up the St. Lawrence and the Welland Canals, by the permission of Canada, who thus has unquestioned command of all our utterly defenceless lake commerce and cities.

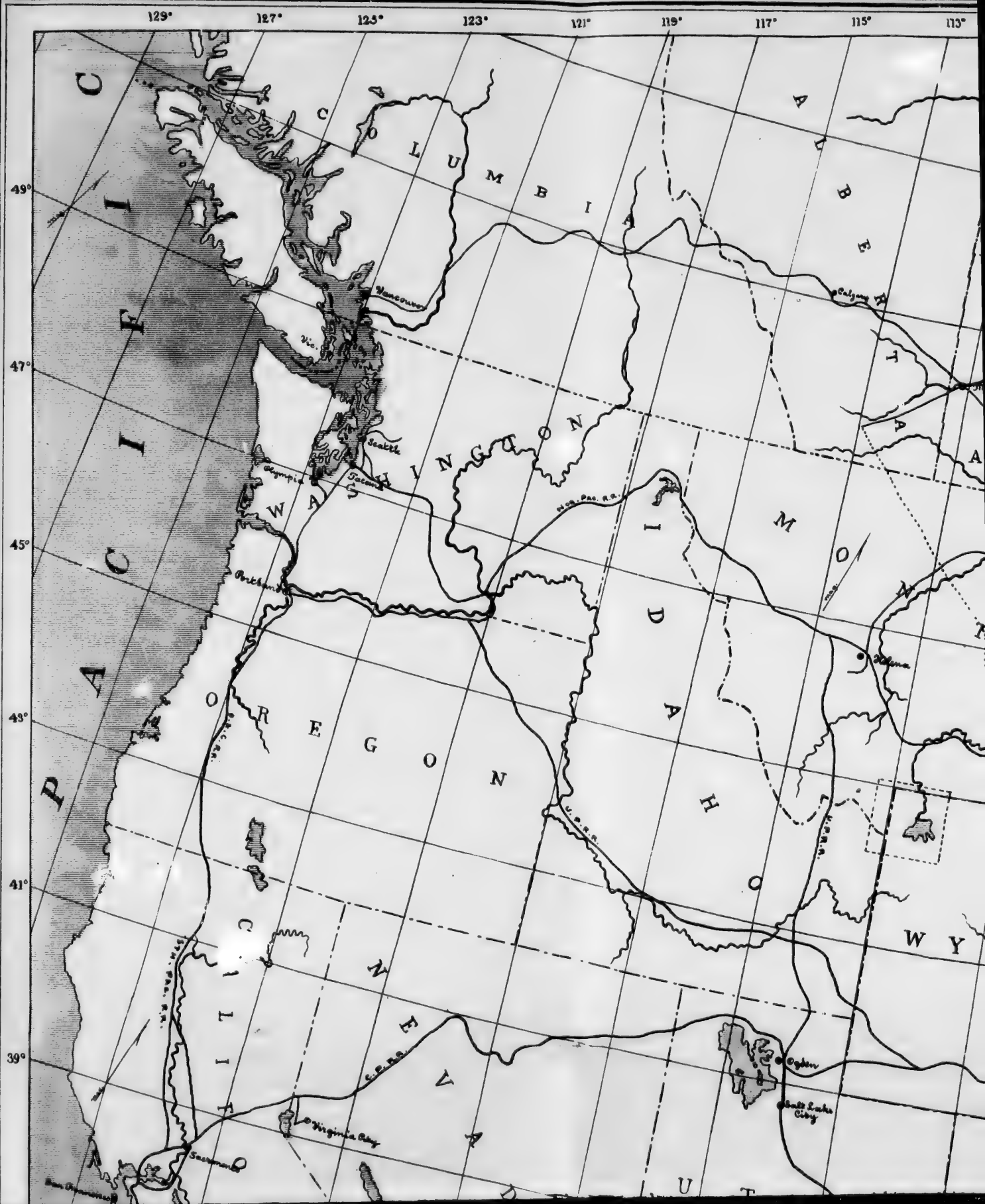
Simply regarded as a military work, the Niagara Ship Canal would be an economical substitute for otherwise needed defences of the Northern frontier. But unlike most military works, it would be still more valuable for peaceful commerce.

MARCH 1, 1890.

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\* Report of the late Mr. James S. Lawrence, C. E., to Major—now Colonel—John M. Wilson, Corps of Engineers, An. Rep. Ch. Engr. U. S. A., 1875, part 2, p. 586. Also, Report Mr. C. A. Olmstead, C. E., to Canal Commissioners, 1871.

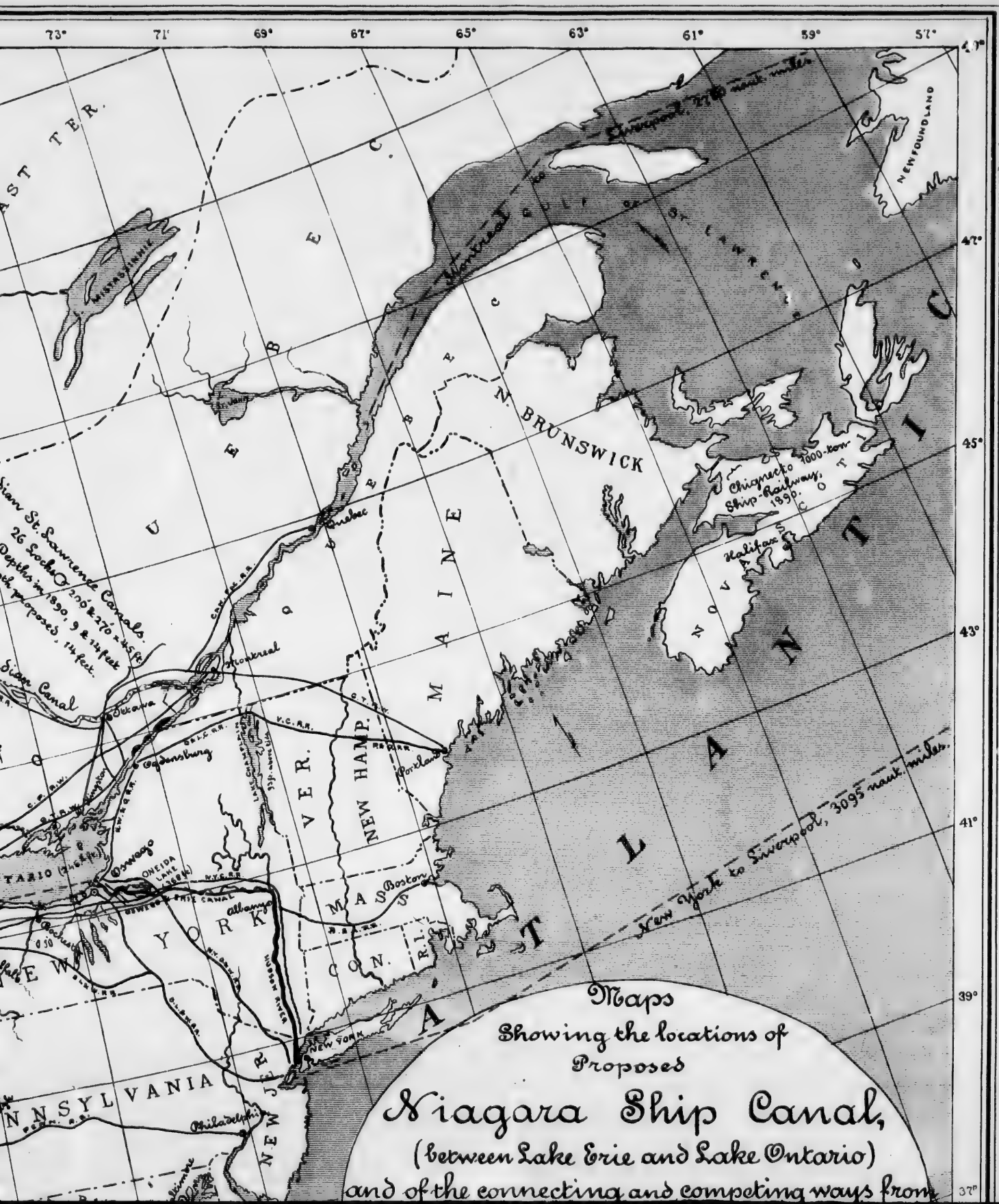


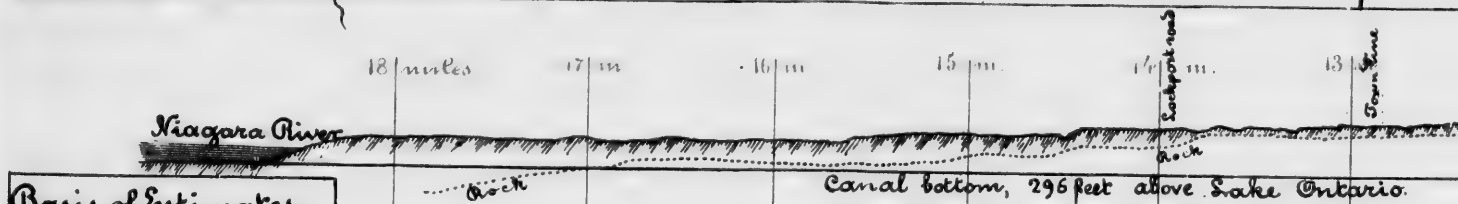












### Basis of Estimates.

#### Locks,

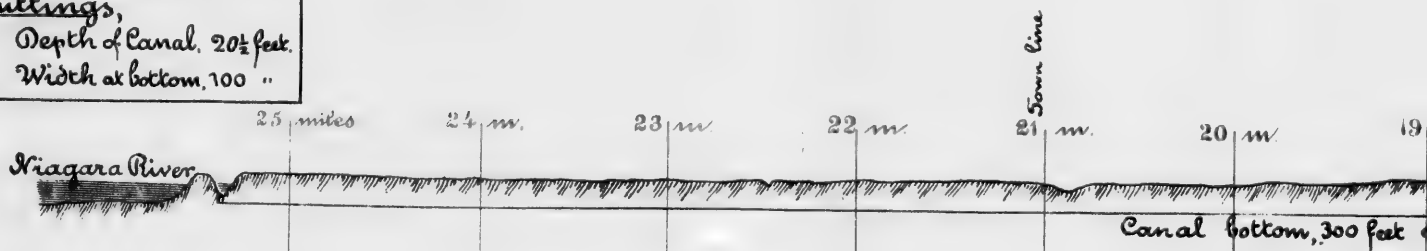
Length, 400 feet  
 Width, 80 "  
 Width of gates, 60 "  
 Depth mitre-sill, 21 "  
 Lift, in general, 18 "  
 Same model as the  
 1881 lock on St. Mary's  
 Falls Canal, Mich.

#### Cuttings,

Depth of Canal, 20½ feet.  
 Width at bottom, 100 "

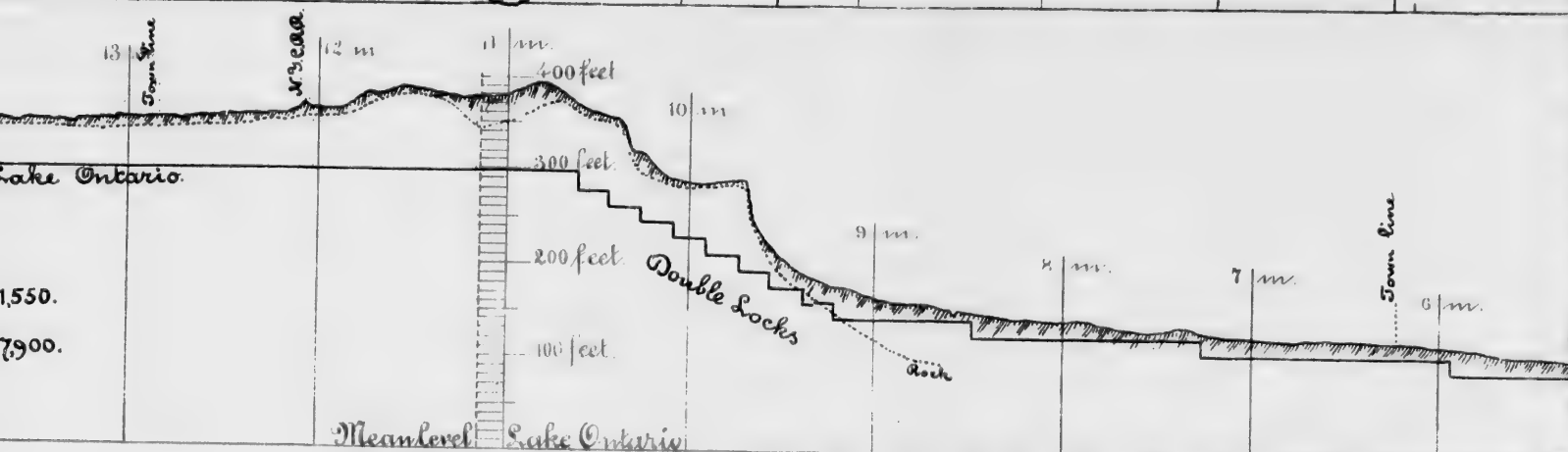
### Estimate of Cost,

{ With single locks, \$24,201,550.  
 With nine double locks, \$29,347,900.

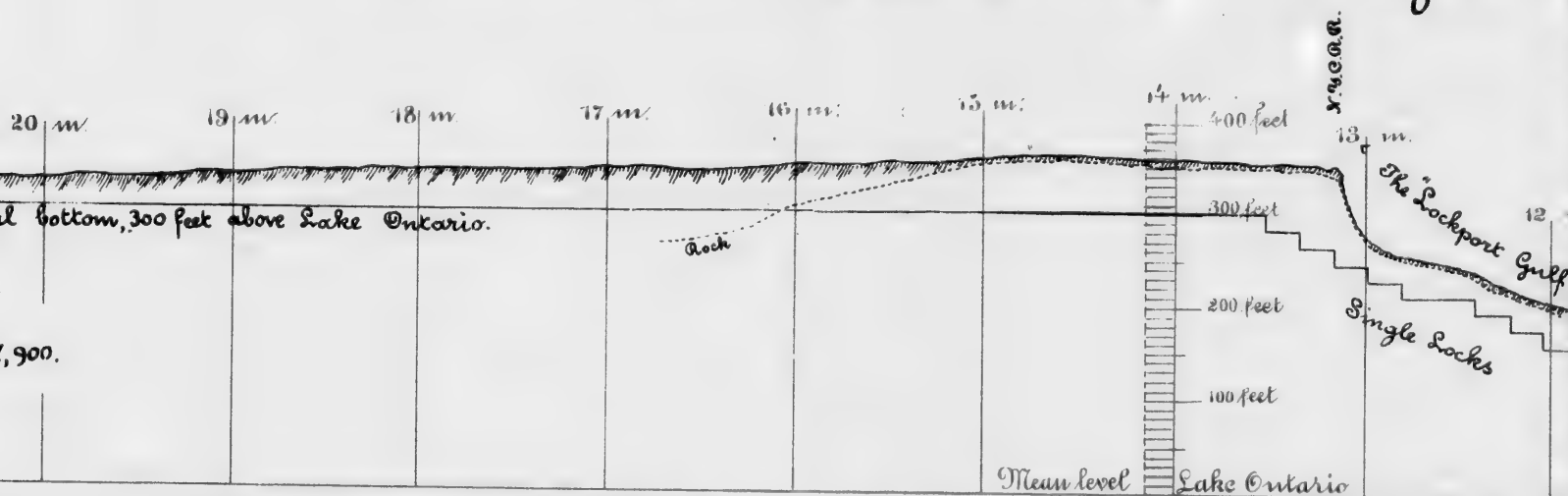


### Estimate of Cost,

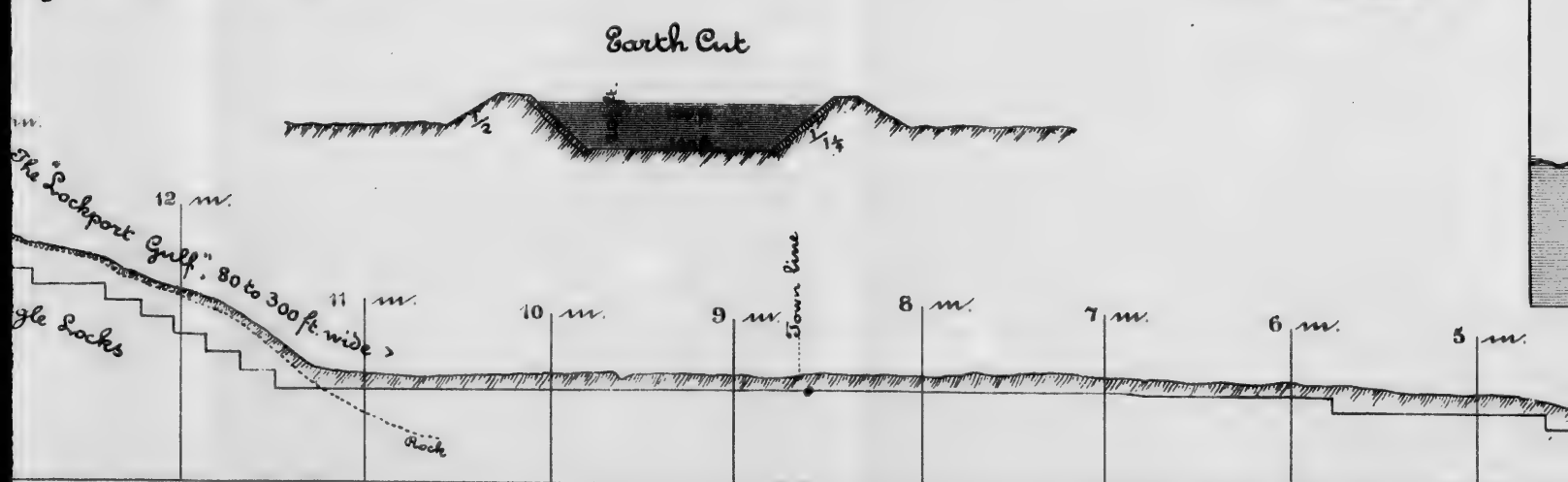
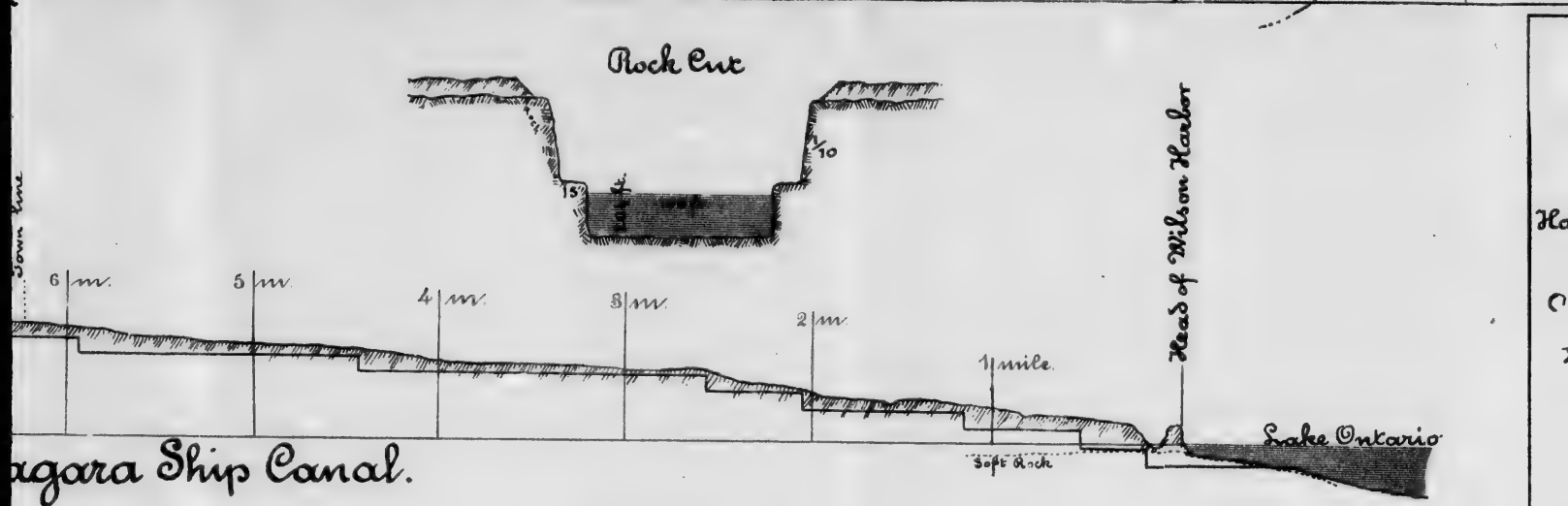
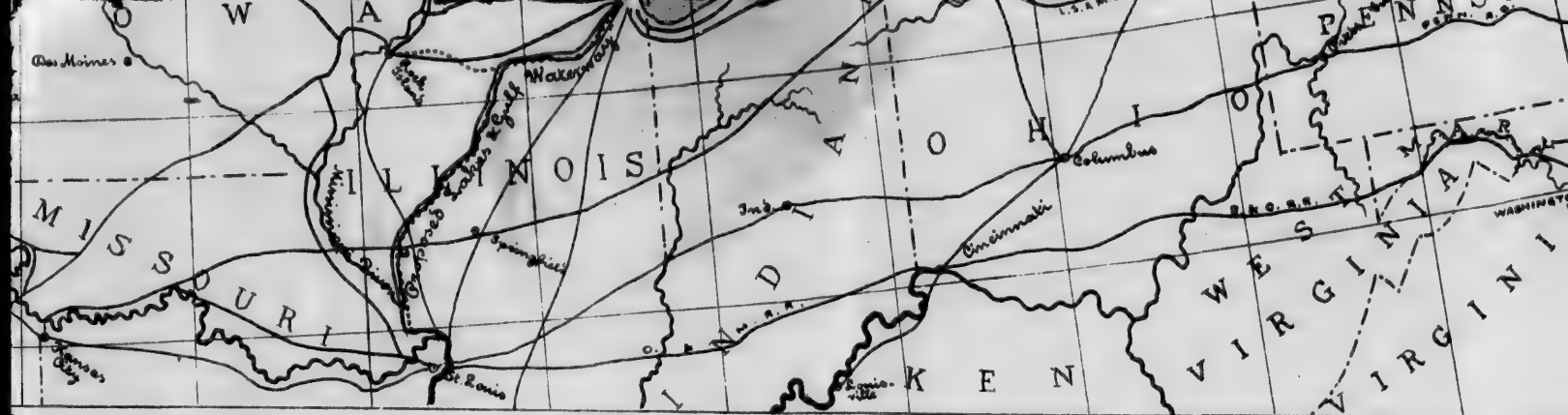
{ With single locks, \$23,617,900.  
 Double locks not needed.



Profile of the Wilson, or Twelve-Mile Creek, route, Niagara St.



Profile of the Lockport-Olcott, or Eighteen Mile Creek, route, Niagara St.





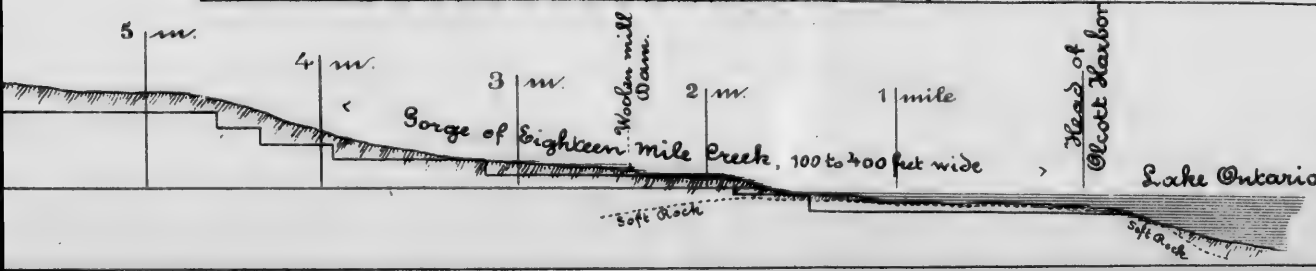
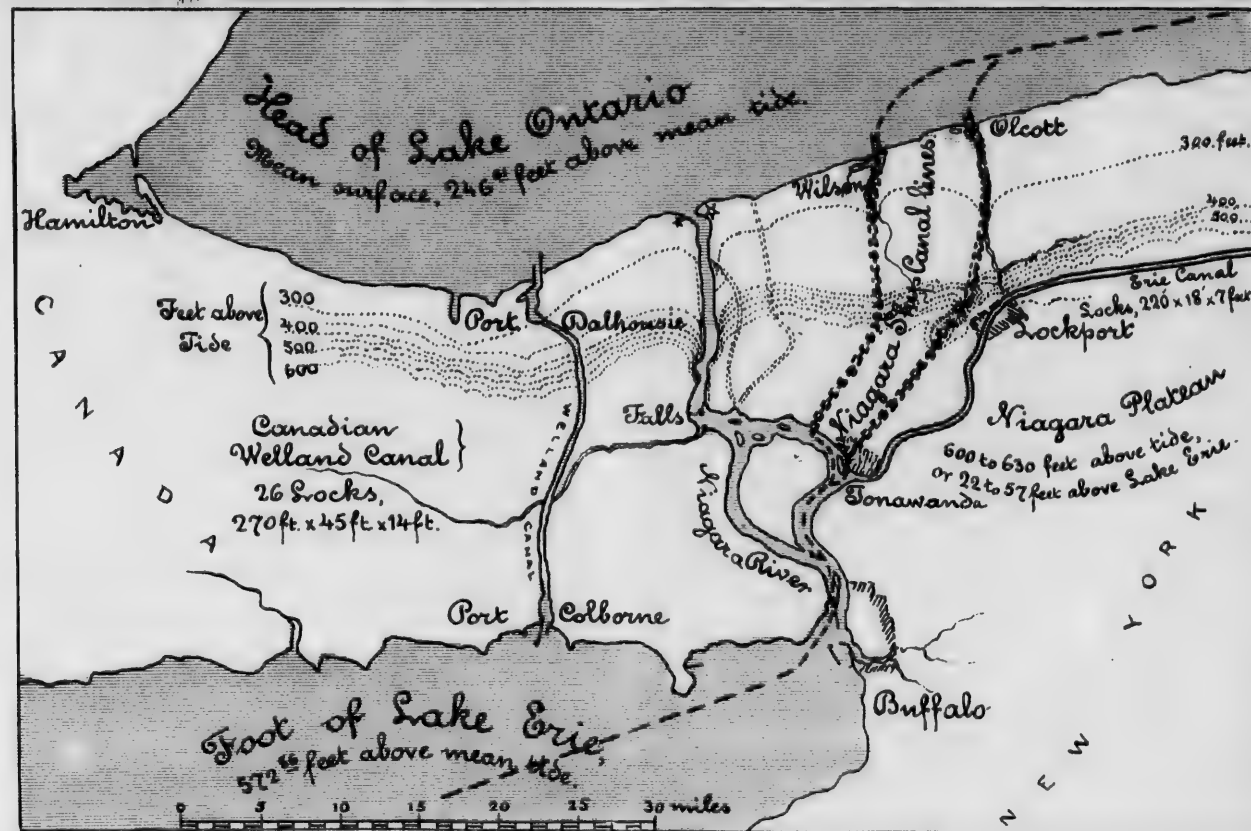
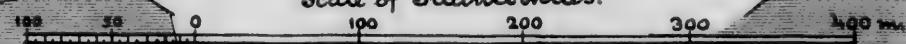


# Niagara Ship Canal

(between Lake Erie and Lake Ontario)  
and of the connecting and competing ways from  
The West & North West to the Sea

Prepared by  
Wm. Pierson Judson, Mem. Am. Soc. C. & E.  
1890.

Scale of Statute Miles.



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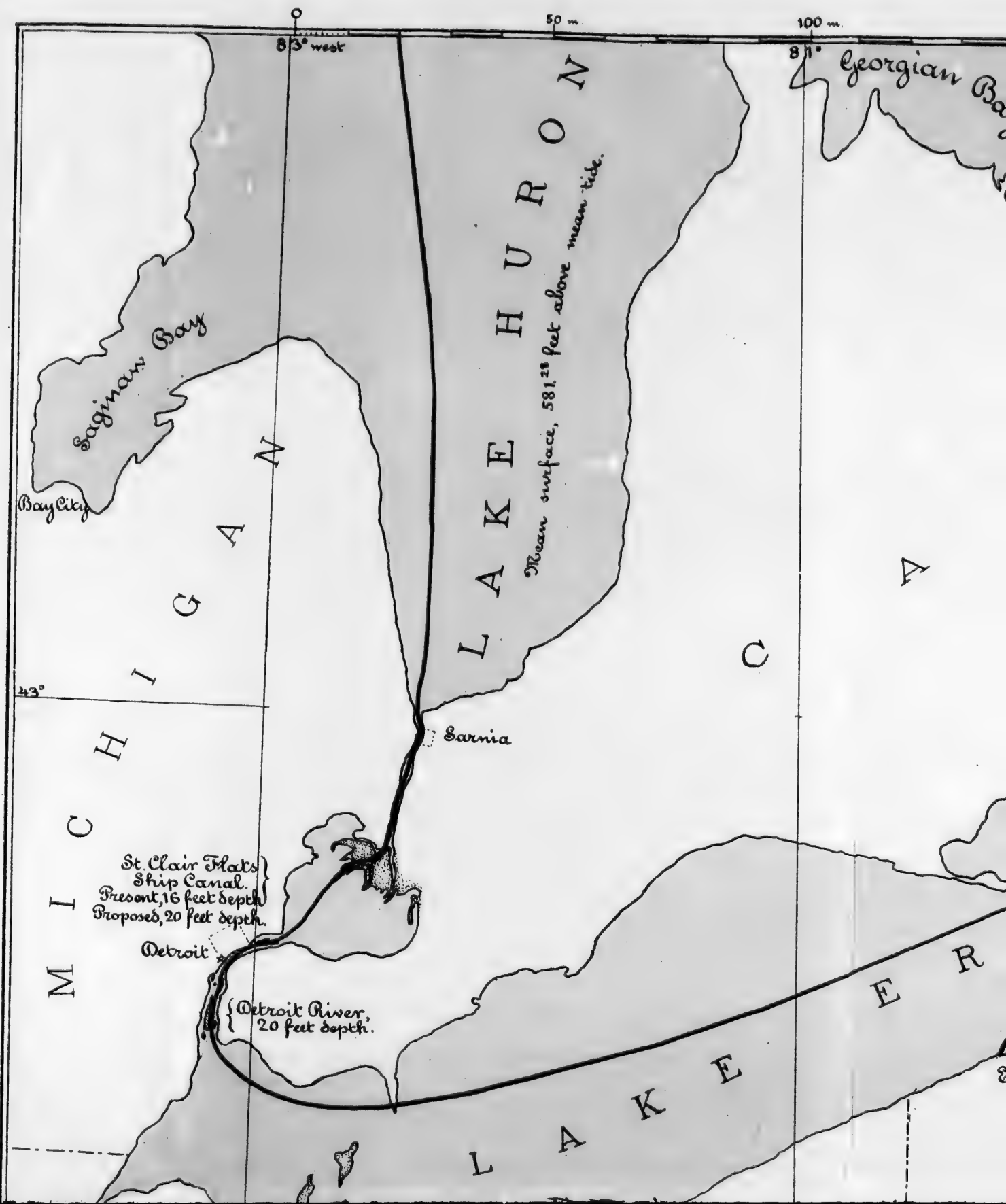
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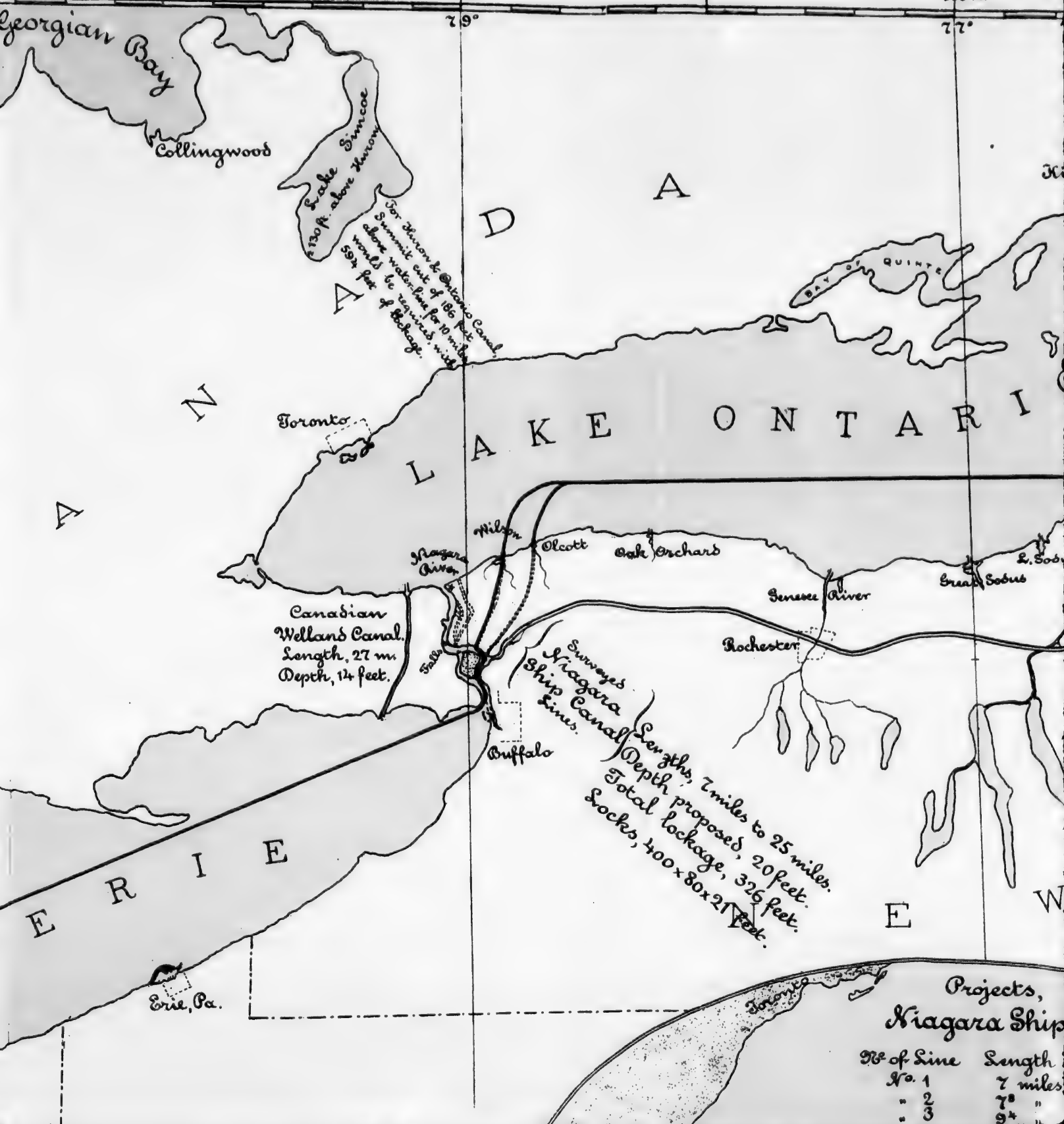
Scale of statute miles.

150 m.

200 miles

250 m.

300 m.





# Projects, Niagara Ship Canal.

of Line	Length	Est'd Cost, 1862, for 14 ft.
No. 1	7 miles	\$ 12 millions
" 2	7 <sup>0</sup> "	11 "
" 3	9 <sup>4</sup> "	11 "

P E N

$75^\circ$ 

burg

Burlington, Vt.

White-  
hall.

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Erie Canal, 7 feet present depth.  
9 feet proposed depth.

Troy

Albany

### Present Canal Navigation.

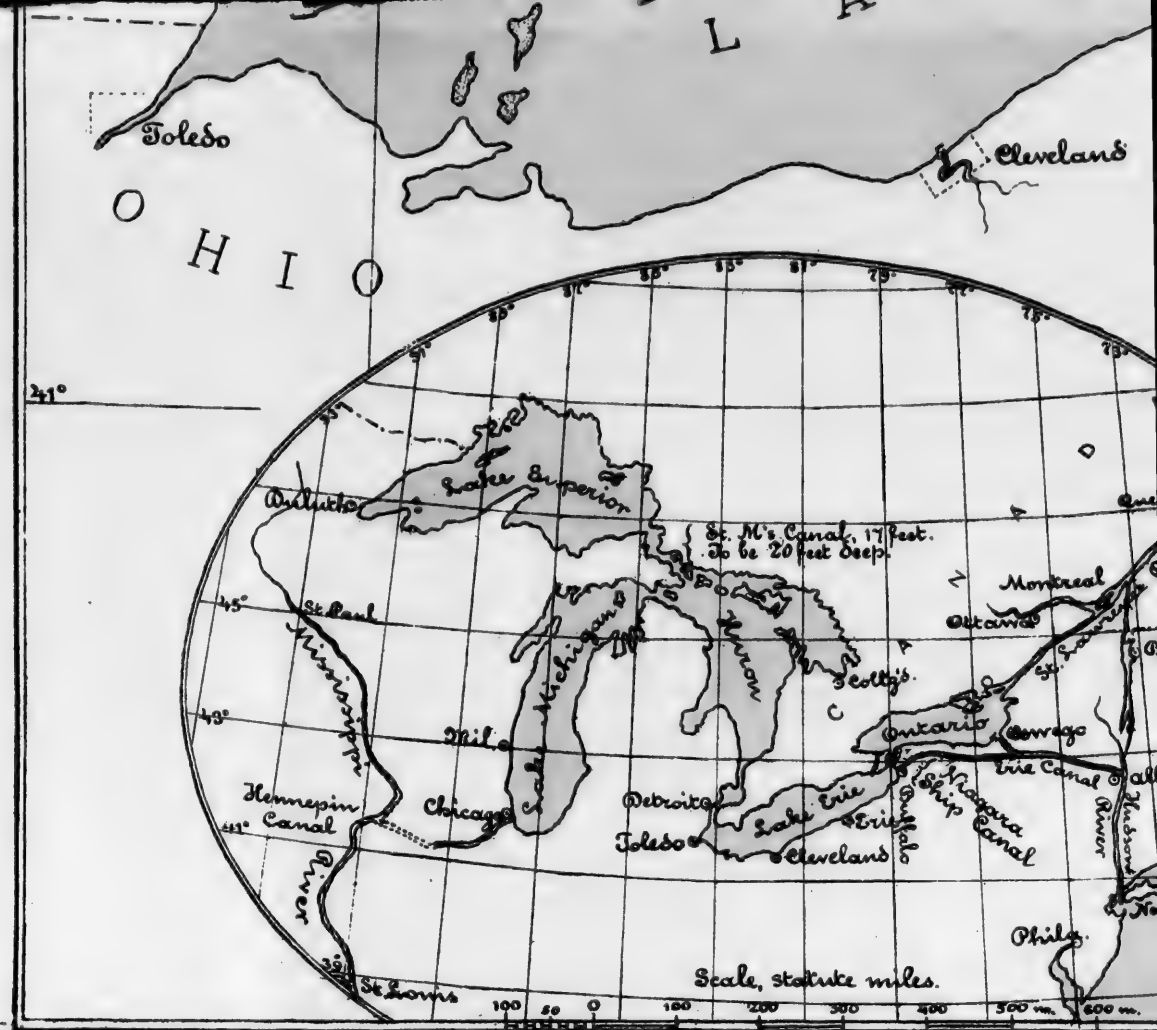
from deep water of Lakes, to Hudson River.

Via Oswego, 206 miles.

Via Buffalo, 352 miles.

Hudson River

14



Cleveland



Maps of proposed  
*Niagara Ship Canal,*  
with the connecting ways  
From the Great Lakes to New York.

Prepared for the  
*Oswego Board of Trade*

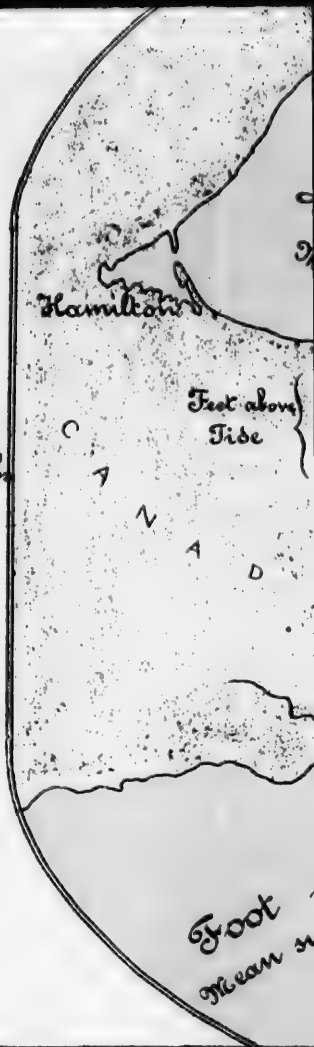
To accompany Report,

By Wm. Pierson Judson,

Mem. Elm. Soc. C. E.

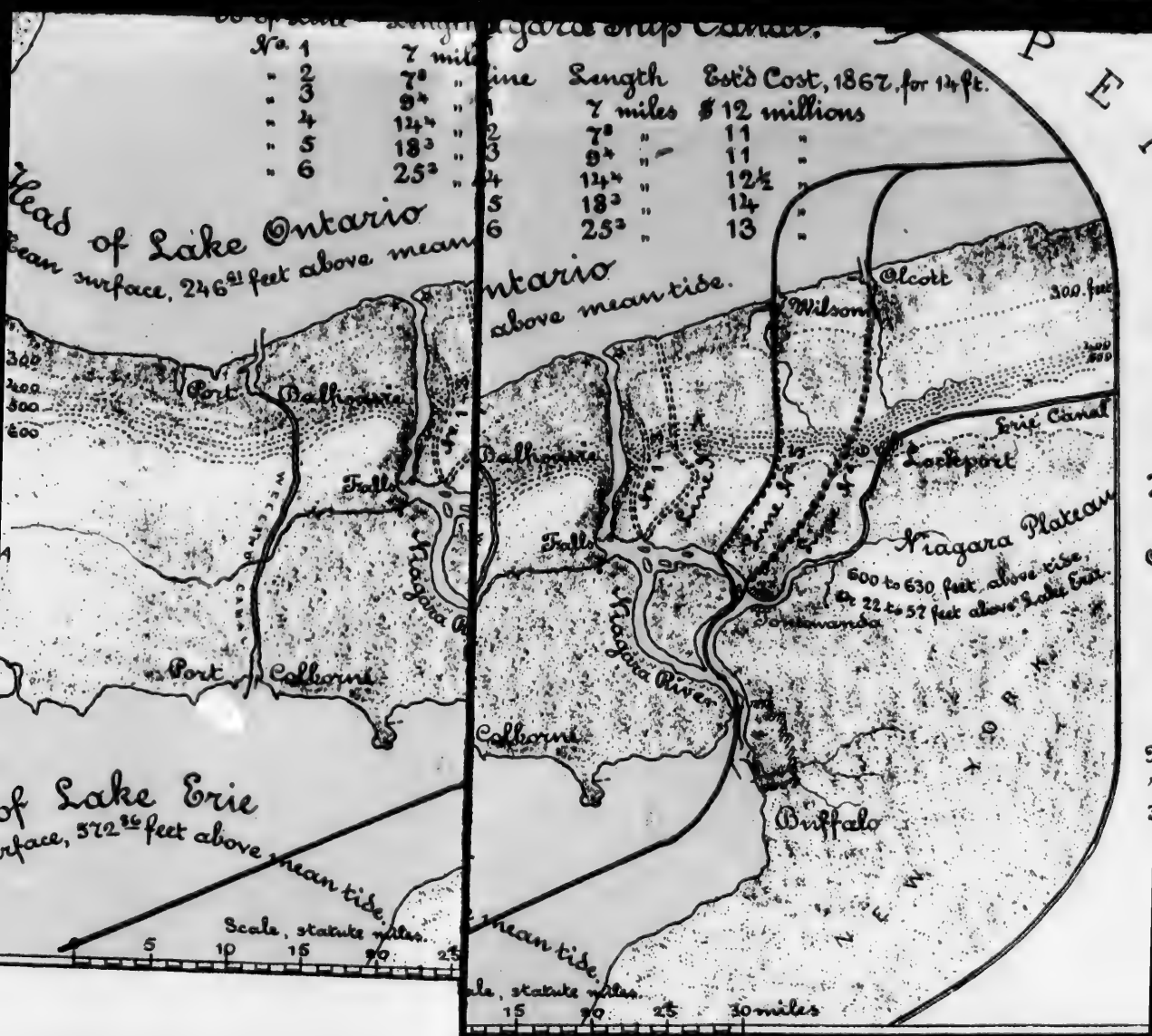
1888.

Second Edition.



No. of Line	Length
No. 1	7 miles
" 2	7 <sup>1</sup> "
" 3	9 <sup>1</sup> "

No. of Line	Length	Est'd Cost, 1867, for 14 ft.
No. 1	7 miles	\$ 12 millions
" 2	7 <sup>1</sup> "	11 "
" 3	9 <sup>1</sup> "	11 "



Height of Summit  
above Lake Erie.

Line No. 1.	22 feet.
" " 2	24 "
" " 3	24 "
" " 4	52 "
" " 5	57 "
" " 6	34 "

Material of Ridge is  
rock covered with 10 to  
100 feet of earth.

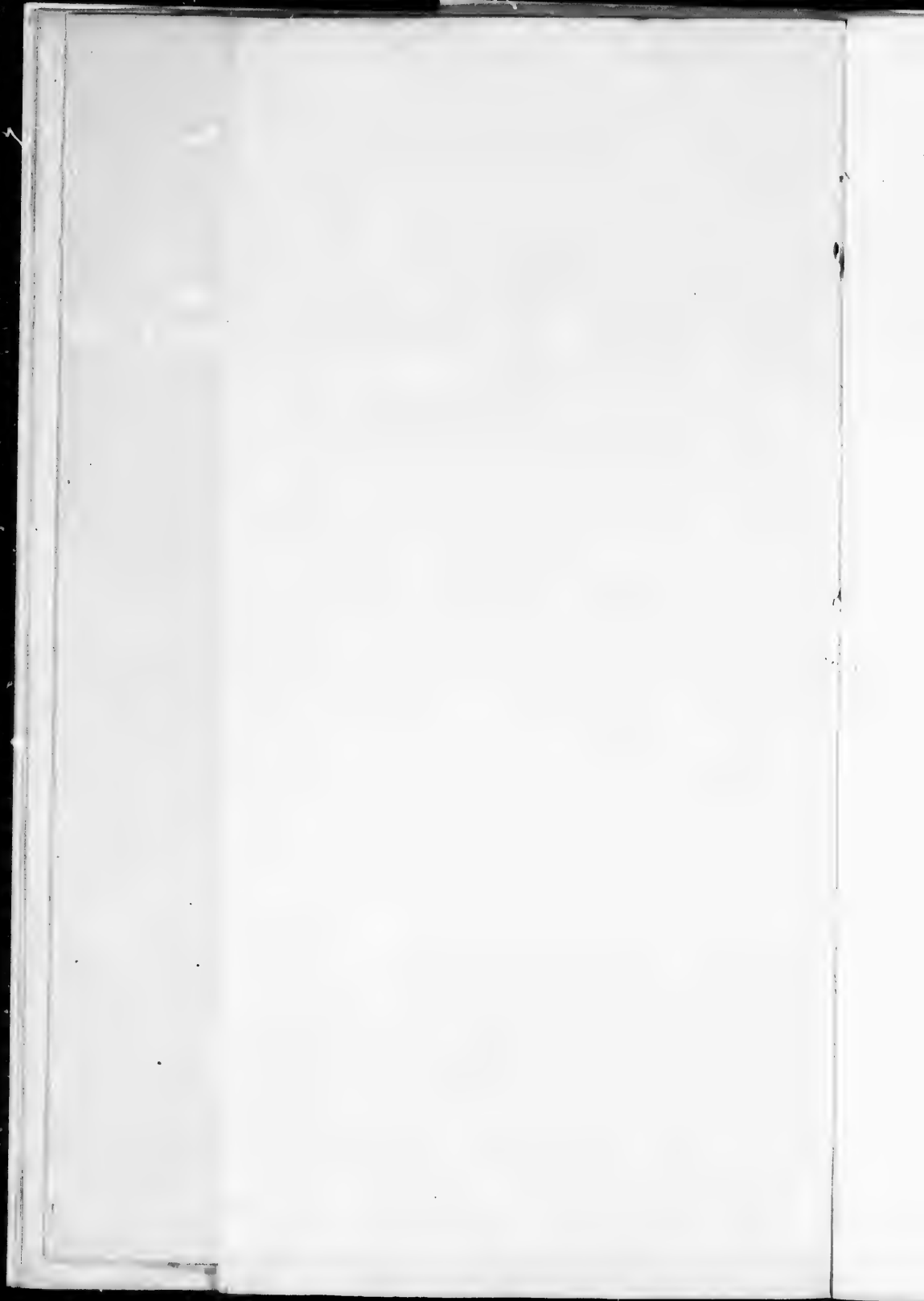
J  
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S  
E  
Y

New York

Brooklyn

Atlantic Ocean









REPORT of Capt. Carl F. Palfrey, Corps of Engineers,  
U. S. A. Reprinted from the Appendix of the Annual  
Report of the Chief of Engineers for 1889, page 2434.

WATERWAY AROUND NIAGARA FALLS OF CAPACITY AND FACILITIES SUFFICIENT TO FLOAT MERCHANT SHIPS AND SHIPS OF WAR OF MODERN BUILD, DRAWING 20 FEET OF WATER, SAID WATERWAY TO COMMENCE IN A NAVIGABLE PART OF NIAGARA RIVER, IN NIAGARA COUNTY, NEW YORK, AT OR NEAR TONAWANDA, AND TO END IN THE NAVIGABLE WATERS OF SAID RIVER BELOW SAID FALLS, OR IN NAVIGABLE WATERS CONNECTED THEREWITH.

UNITED STATES ENGINEER OFFICE,  
August 19, 1889.

The CHIEF OF ENGINEERS, U. S. A.,  
Washington, D. C.:

*General*,—I have the honor to report as follows upon revision of surveys and estimates for waterway around Niagara Falls, New York, heretofore made by Col. C. E. Blunt, Corps of Engineers.

The river and harbor act of August 11, 1888, under which this revision is made, contains the following paragraph:

Waterway around Niagara Falls of capacity and facilities sufficient to float merchant ships and ships of war of modern build, drawing 20 feet of water, said waterway to commence in a navigable part of Niagara River, in Niagara County, at or near Tonawanda, and to end in the navigable waters of said river below said falls, or in navigable waters connected

therewith. For the purposes hereof the Secretary of War, in his discretion, may take into consideration, and revise the surveys and estimates of such a waterway heretofore made by Brevet-Colonel C. E. Blunt, of the United States Corps of Engineers, in compliance with a joint resolution of the Congress approved March twenty-second, eighteen hundred and sixty-seven.

The canal for which Colonel Blunt made surveys and estimates was of 14 feet depth, with lock-chambers 275 x 46 feet. His surveys covered six lines, some of which presented great difficulty in the ascent of the Niagara Terrace even with these dimensions, and only one, the longest, offered any marked natural advantage. None of these is impossible with the dimensions now required; routes No. 1, 2, 2a, 3, and 5a do not come within the description of the act above cited, the last being without Niagara County, the others opening upon Niagara River 9 miles below the present termination of a 20-foot depth. No estimates upon these are therefore presented. Examination of the ground and application of the present project to the profiles of these routes have shown me that they offer no advantage either in expense of construction or efficiency of service. Route No. 4 also opens upon the river at a point below the present termination of 20-foot depth, but near enough to it to come reasonably within the terms of the act. Of all the routes surveyed by Colonel Blunt it is the only one remaining for comparison with route No. 5. Projects and estimates upon these two routes are therefore presented.

The dimensions of canals and locks adopted and used in all the estimates are as follows :

	Depth.
Width of canal at bottom.....	100
Depth of canal.....	20 $\frac{1}{2}$
Width of canal at water-surface in rock...	100
Width of canal at water-surface in earth..	150
Length of lock-chamber.....	400
Width of lock-chamber .....	80
Width of gates.....	60
Depth over miter-sill.....	21
Lift, in general.....	18

I assume that the lock at Sault Ste. Marie, Mich., completed in 1881, as the model of locks and their works, and also assume that the canal will be used by vessels either self-propelling or towed by tugs. All slopes are therefore paved.

The sections herewith presented show the form of cutting upon which estimates are based. I have arranged upon both routes for the ascent of the Niagara Terrace by a system of locks 400 feet long and 80 feet wide, and short levels or basins 500 feet long and 100 feet wide. With this system, for draught of 14 feet, the lock can be filled from its own basin and the lock next above without danger from grounding; for draught of 16 feet the lock can be filled from its own basin and the basin next above without danger of grounding in either; for draught of 17 feet, from its own basin and the two above without danger of grounding in any.

Upon route No. 4 this gives fairly efficient service with single locks, but for full efficiency double locks are still needed upon this route. Upon route No. 5, by virtue of a level of 2,100 feet midway of the ascent, efficient service can be had from single locks.

At the lake end of each route is a shallow natural harbor, with harbor improvements on a scale utterly inadequate to the needs of this waterway.

At each I estimate for a channel 200 feet wide to the deep water of the lake, protected by piers of crib-work filled with stone. At each harbor the inner 500 feet of this channel is in water fully protected from storm, being part of the natural harbor.

At each lake-front the bottom of the lake is of a soft red stone, which can be worked by the dredge. A similar formation at Oak Orchard has been removed by dredging to a depth of 10 feet at extreme low water (12 feet at ordinary low water), at a contract price of \$1.10 per cubic yard.

The requirements of bridging are not materially changed since the date of Colonel Blunt's report. The surface width of the canal is unchanged, and I have held, where there is any change, to lower levels than he. In the wide range of estimate open in this matter I have held to his.

## ROUTE NO. 4—WILSON OR TWELVE-MILE CREEK LINE.

Length, 18.35 miles; 18 lifts; estimated cost with single locks, \$24,201,550; estimated cost with double locks, \$29,347,900.

"This line commences at the mouth of Twelve-Mile Creek, and following its course about half a mile, the line reaches the table-land, and thence in a southerly course for  $9\frac{1}{2}$  miles over gently-rising ground, very favorable for the location of a canal, it reaches the foot of the mountain ridge. At this point the ascent commences, and a second table-land is passed. Continuing a southerly course, the line crosses the Pekin road, and half a mile farther the summit is reached, the line descending into the valley of Cayuga Creek to the Lockport and Niagara Falls Railroad. From thence it takes a southwest course along the valley of the creek to Bergholtz; thence nearly on the same course to its termination at a point on the Niagara River, two miles east of Cayuga Creek, the whole distance being 18.35 miles."

Beginning at the mouth of Twelve-Mile Creek, this line rises, with nine lifts and with levels ranging from 2,000 to 9,750 feet, to the base of the cliff. This portion of the line is entirely in earth-cutting. The natural surface of the ground is fairly uniform. It is highly cultivated in wheat and fruit. The ascent of the cliff is made by nine lifts of  $17\frac{1}{4}$  feet each, with levels uniformly 500 feet long between, thus reaching the summit level, fed from the Niagara River. The cliff is abrupt, with a thin cover of earth over most of its face. The crest is at about 60 feet above water-level. There is a secondary terrace about two lifts below the summit-level. It could be utilized for a level only by giving up the intermediate basins through the whole system and incurring the expense of double locks, and even then, leaving three-quarters of the ascent unbroken, it would add little to efficiency. On the summit level this line is very expensive by the depth of the rock-cut. The system of locks and basins gives on this line a moderate efficiency, with single locks, for draught of 14 feet. For the deeper draughts, although passing on the incline is possible, with careful management, at several points, the service of the upper locks must often be sacrificed

to the need of replenishing the lower. For full efficiency double locks are necessary, which adds largely to the expense of the line. The locks to be doubled are all in rock-cutting, where masonry is reduced to the minimum, and the expense of double locks in these circumstances is nearly double that of single ones.

In the Niagara River this line requires a dredged channel about 16,700 feet long. This is estimated as in sand and gravel, as the rock-beds are uniform, and no rock appears in the bed of the river for many miles.

One railroad bridge is required on this line not included in Colonel Blunt's estimate. The Rome, Watertown and Ogdensburg Railroad crosses the line at a level little above the water-surface.

The lake harbor estimated for includes a moderate area of sheltered mooring. Should commercial needs require it, a basin can be obtained by dredging in Wilson Harbor.

#### ROUTE NO. 5.—OLCOTT OR EIGHTEEN-MILE CREEK ROUTE.

Length, 25.28 miles; lifts, 18; estimated cost, \$23,617,900.

"The line of survey begins at the head of Olcott Harbor, on Lake Ontario, 18 miles east from the mouth of the Niagara River, following the channel of Eighteen-Mile Creek (the course of which is nearly south and very direct) for  $3\frac{1}{4}$  miles; ascending gradually, reaches in  $1\frac{1}{2}$  miles the table-land, over which it passes for  $5\frac{3}{4}$  miles nearly south to the foot of the mountain ridge, when it enters another valley or gulf  $2\frac{1}{4}$  miles in length, varying in width from 80 to 300 feet on the bottom, which is gradually ascending with steep banks on both sides; this is followed to its head, where the mountain ridge is encountered. From the head of the gulf the line follows a slight depression in the ridge, leading in a tolerably direct course west of south 4 miles to the east end of Beach Ridge; thence by an almost direct line nearly southwest to the Niagara River, opposite the north end of Tonawanda Island, about seven-eighths of a mile north of the mouth of Tonawanda Creek, making the whole distance 25 miles 22.34 chains."



Beginning at the mouth of Eighteen-Mile Creek, this line rises by seven lifts to the entrance of a remarkable gorge in the face of the cliff near Lockport, locally known as "The Gulf."

In this part of the line there is little rock-cutting in the bed of the creek and at leaving it; thereafter it is all in earth-cutting. It has the advantage of one level nearly 6 miles long, in which good speed can be maintained. The country traversed after leaving the creek is in part cultivated in wheat; in part hay land. "The Gulf" offers a comparatively easy ascent of the cliff by four lifts with levels or basins 500 feet long; then one lift with basin 800 feet long; then one lift and level 2,100 feet long; then five lifts having intermediate basins 500 feet long, to the summit level. On the summit level this line is free from rock-cutting after less than 3 miles.

On this line efficient service can be had from single-locks. The level midway of the ascent is an important aid. For 14-foot draught one lock full of water can be taken from the 800-foot level and two from the 2,100-foot level for the service of the lower locks before drawing from the summit level through the upper locks becomes necessary. For 16 and 17 foot draughts one lock full can be so drawn from the 2,100-foot level. The terrain of the gorge makes it easy to provide a storage basin of very moderate depth, into which water may be allowed to fall from the summit level and thence drawn off without inconvenient head to the 2,100-foot level. This would leave the upper set of five locks entirely free from the service of replenishing the lower set, and would add greatly to the efficiency of the system.

In the Niagara River this line requires a dredged channel about 5,000 feet long. The 20-foot depth appears again farther down the river. The bar between White's Island and the mainland is therefore estimated as sand and gravel.

The bridge of the Rome, Watertown and Ogdensburg Railroad, not built at the time of Colonel Blunt's report, crosses this line where it occupies the bed of Eighteen-Mile Creek at a level far above the water-surface. One-half the cost of a bridge is estimated for changing this to a swing-bridge.

The lake harbor-works estimated for include a moderate area of sheltered mooring. Should commercial needs require it, a basin can be obtained by dredging in Olcott Harbor. Detailed estimates upon the two routes are appended. Profiles and sections are herewith presented.

I have the honor to be, very respectfully,

Your obedient servant,

CARL F. PALFREY,  
*Captain of Engineers.*

## DETAILED ESTIMATE.

## ROUTE No. 4 (WILSON ROUTE).

With single locks:

Excavation for levels and locks:

Earth, 7,152,000 cubic yards, at 25 cents,	\$1,788,000
Rock, 6,340,000 cubic yards, at \$1.25 .....	7,925,000
Slope walls, 237,000 cubic yards, at \$1.50,	355,500

Locks:

In rock cutting, 8 at \$460,000,	\$3,680,000
In earth cutting, 10 at \$660,000,	6,600,000
Guard lock, 1 .....	420,000
	<hr/>
	10,700,000

Movable dam in summit level .....	100,000
Bridges .....	138,000
Contingencies, 10 per cent .....	2,100,650
	<hr/>
	\$23,107,150

Lake harbor:

	Feet.	
Extension east pier .....	1,000	
New west pier .....	1,700	
	<hr/>	
	2,700, at \$60.---	162,000

Channel 200 feet wide, 2,300 feet long:

250,000 cubic yards rock, at \$1.50 .....	375,000
Contingencies, 20 per cent .....	107,400
Dredging in Niagara River, 1,500,000 cubic yards, at 30 cents .....	450,000
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Grand total .....	<u>\$24,201,550</u>
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## With double locks:

Estimate as above .....	\$24,201,550
Additional excavations:	
Earth, 942,000 cubic yards, at 25 cents.....	\$235,500
Rock, 242,400 cubic yards, at \$1.25.....	303,000
Additional cost of 9 double locks, at \$460,000 .....	4,140,000
Contingencies, 10 per cent.....	467,850
Total additional .....	5,146,350
Grand total .....	<u>\$29,347,900</u>

## DETAILED ESTIMATE.

## ROUTE No. 5 (OLCOTT ROUTE).

## With single locks:

Excavation for levels and locks:	
Earth, 12,954,000 cubic yards, at 25 cents..	\$3,238,500
Rock, 4,641,000 cubic yards, at \$1.25.....	5,801,250
Slope walls, 390,000 cubic yards, at \$1.50..	585,000
Locks:	
In rock cutting, 7, at \$460,000..	\$3,220,000
In earth cutting, 11, at \$660,000..	7,260,000
Guard lock, 1 .....	420,000
	10,900,000
Movable dam in summit level.....	100,000
Bridges .....	164,800
Contingencies, 10 per cent.....	2,078,950
	<u>\$22,868,500</u>
Lake harbor:	
	Feet.
Extension east pier .....	1,000
New west pier.....	1,700
	2,700, at \$60...
Channel, 200 feet wide, 2,300 feet long, 250,000 cubic yards rock, at \$1.50.....	162,000
Contingencies, 20 per cent.....	375,000
	107,400
Dredging in Niagara River:	
350,000 cubic yards, at 30 cents.....	105,000
Grand total .....	<u>\$23,617,900</u>

51ST CONGRESS,  
1ST SESSION.

## H. R. 582.

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IN THE HOUSE OF REPRESENTATIVES.

DECEMBER 18, 1889.

Read twice, referred to the Committee on Railways and Canals, and ordered to be printed.

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Mr. PAYNE introduced the following bill :

### A BILL

Directing the United States of America to make a ship-canal around Niagara Falls, in the State of New York.

*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,* That there be made by the United States of America, around the Falls of Niagara, in the county of Niagara, in the State of New York, a navigable canal for the passage of merchant ships and ships of war from Lake Ontario to Lake Erie, or the navigable waters connected therewith.

SEC. 2. That the said ship-canal shall be located in Niagara County, in the State of New York, along and upon one of the routes for a ship-canal heretofore surveyed and estimated for by the United States. Said ship-canal shall be located by a board composed of five men, to be chosen and appointed by the President of the United States, and such

choice and appointment shall be made within three months after the passage of this act. Two of said men shall be chosen from the United States Corps of Engineers, two shall be civil engineers of recognized skill, chosen from civil life, and one of said five men shall be chosen from the members of the board of trade of the city of Chicago. All said men shall be citizens and residents of the United States of America.

SEC. 3. That within four months after the President shall have chosen the men to form the board described in section two of this act, the said board shall revise the existing plans, surveys, and estimates for a canal within the county of Niagara, around the Falls of Niagara, and so modify the same, that when the ship-canal shall be made, provided for in this act, the same will be of sufficient width, depth, and capacity to easily, safely, and expeditiously float, along its whole length, vessels of as great length, width, depth, and tonnage as can be floated through the Saint Mary's Falls canal and locks when said Saint Mary's Falls canal and locks shall be completed according to the present project and plans of the United States thereabout. Ten thousand dollars, or so much thereof as may be necessary, is hereby appropriated out of any moneys unexpended in the United States Treasury, to pay the expenses of said board and to pay for the services of such of the men on said board as may not be under pay from the United States. The Secretary of War of the United States shall have the power, and it shall be his duty, to fix the compensation of said men on said board and shall pay them from the sum hereinbefore appropriated.

SEC. 4. That when the route of said ship-canal shall have been by said board designated and located the Secretary of War shall have the power, and it shall be his duty, to acquire the title to the lands, water property, and right of way for said canal. The title of said property shall be taken in the name of the United States of America, and may be procured by donation, purchase, or condemnation. If it shall be necessary to procure any of said property to enable said canal to be built by condemnation, the Secretary of War aforesaid is hereby authorized and directed to commence

and prosecute to final judgment, or until title be obtained, any and all actions, suits, or proceedings necessary to obtain such title. Said actions, suits, or proceedings shall be commenced and prosecuted in the name of the United States of America, as petitioner or plaintiff, against any and all persons or things as defendants, as shall be necessary, and such suits, actions, or proceedings may be commenced and prosecuted under the laws of the State of New York and the practice as laid down by its courts.

SEC. 5. That the sum of one million dollars is hereby appropriated, out of any money in the Treasury of the United States which is unappropriated and unexpended, to be applied under the terms of this act to the construction of said ship-canal. The said ship-canal shall be made and built as in this act provided, under the direction and supervision of the Secretary of War of the United States. And the Secretary of War shall, from time to time, report to the Congress of the United States the progress made toward the completion of said canal under this act.

SEC. 6. That this act shall take effect immediately.

